

WALLOWA-WHITMAN NATIONAL FOREST
FISHERIES HABITAT IMPROVEMENT
ANNUAL REPORT FY 1988

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GRANDE RONDE RIVER SUBBASIN

UPPER NORTH FORK JOHN DAY RIVER SUBBASIN

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INTRODUCTION

This report describes fisheries habitat improvement accomplishments on the Wallowa-Whitman National Forest (NF) during FY 1988 (April 1, 1988 - March 31, 1989). This multi-year, multi-phase fish habitat improvement effort which began in 1984, is funded under the amended (1987) Northwest Power Planning Council's Columbia River Basin Fish and Wildlife Program, Measure 703(c)(1), Action Item 4.2. Principal program funding is being provided by the Bonneville Power Administration (BPA).

The overall Forest fisheries program goal is to optimize anadromous spawning and rearing habitat conditions for juvenile and adult chinook salmon and steelhead trout, thereby maximizing snikt production as a mitigation measure for fishery losses due to the mainstem Columbia River hydroelectric system.

Project activities are located on four Ranger Districts (RD) within the Wallowa-Whitman National Forest. The Baker and Unity RD administer the upper headwater portions of the North Fork of the John Day River. The Umatilla National Forest (NF) administers the remaining downstream sections on NF lands. The La Grande, Wallowa Valley, and Eagle Cap RD's and Hells Canyon NRA administer streams on NF lands within the Grande Ronde River subbasin; the La Grande RD being responsible for the Upper Grande Ronde and the other units the Lower Grande Ronde and tributaries.

Subbasin Descriptions, Fisheries Resources, and Limiting Factors

The Grande Ronde River subbasin is comprised of a drainage area of approximately 4,070 square miles which includes such major streams as Joseph Creek and Catherine Creek, the Upper Grande Ronde, Wenaha, Wallowa, Lostine, and Minam Rivers, and a few smaller tributaries 1/. The Upper Grande Ronde Drainage, approximately 1,622 square miles above the confluence of the Grande Ronde and Wallowa Rivers, currently contains three ongoing improvement projects on NF lands (Figure 1). The Joseph Creek drainage, a major drainage within the Lower Grande Ronde River, drains approximately 556 square miles and contains four major ongoing projects (Figure 2). While these upstream areas are all on NF lands, those lands below the headwaters lie primarily in private ownership. Streamflow patterns in the Grande Ronde exhibit typical spring floods common to northeast Oregon streams with minimum flows usually occurring in August or September.

The North Fork of the John Day River originates on the northeast slopes of Columbia Hill, a peak of the Elkhorn Mountain Range within the North Fork John Day Wilderness. After three miles, the stream leaves wilderness at Peavy Cabin, a local landmark, and reenters the wilderness near the North Fork John Day Campground, approximately seven miles of non-wilderness stream. The North Fork of the John Day River is under consideration for addition to the National Wild and Scenic Rivers System. The river and its tributaries provide over 40 stream miles of salmon and steelhead habitat.

Anadromous fish contend with the lower three Columbia River dams with regard to upstream and downstream passage. Figure 3 identifies several John Day subbasin fisheries improvement projects on NF lands. Additional projects may be planned following additional study during FY 89.

The Grande Ronde River subbasin supports both natural and hatchery runs of spring chinook salmon and steelhead trout. Natural rainbow trout are also produced along with a remnant coho salmon run. Chinook salmon juveniles used for hatchery supplementation of natural stocks are currently being produced at Looking Glass Hatchery. A new chinook and steelhead adult trapping and juvenile outplanting facility was recently constructed (1987) at the confluence of Deer Creek (Big Canyon) and the Wallowa River. The Joseph Creek subbasin is managed strictly for wild steelhead production. Current steelhead production potential for the Grande Ronde Basin is estimated at 16,566 adults and 432,844 smolts. 2/ However, actual production is estimated to be near 10-20 percent of potential due to mainstem passage problems for juveniles and adults.

The John Day River subbasin supports the largest remaining, exclusively wild runs of spring chinook and summer steelhead in Northeast Oregon, the North Fork of the John Day River being the most important anadromous producer in the subbasin.

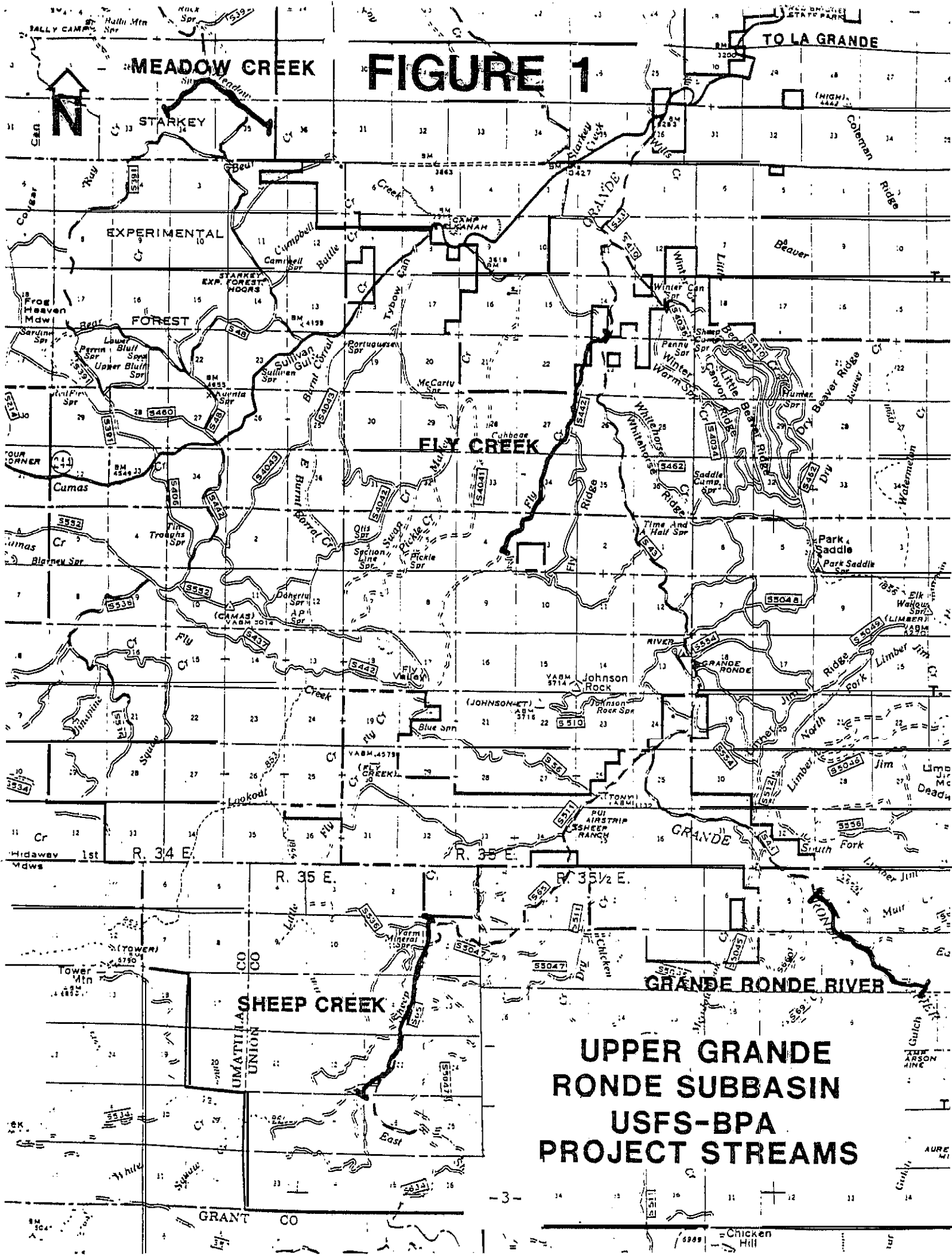
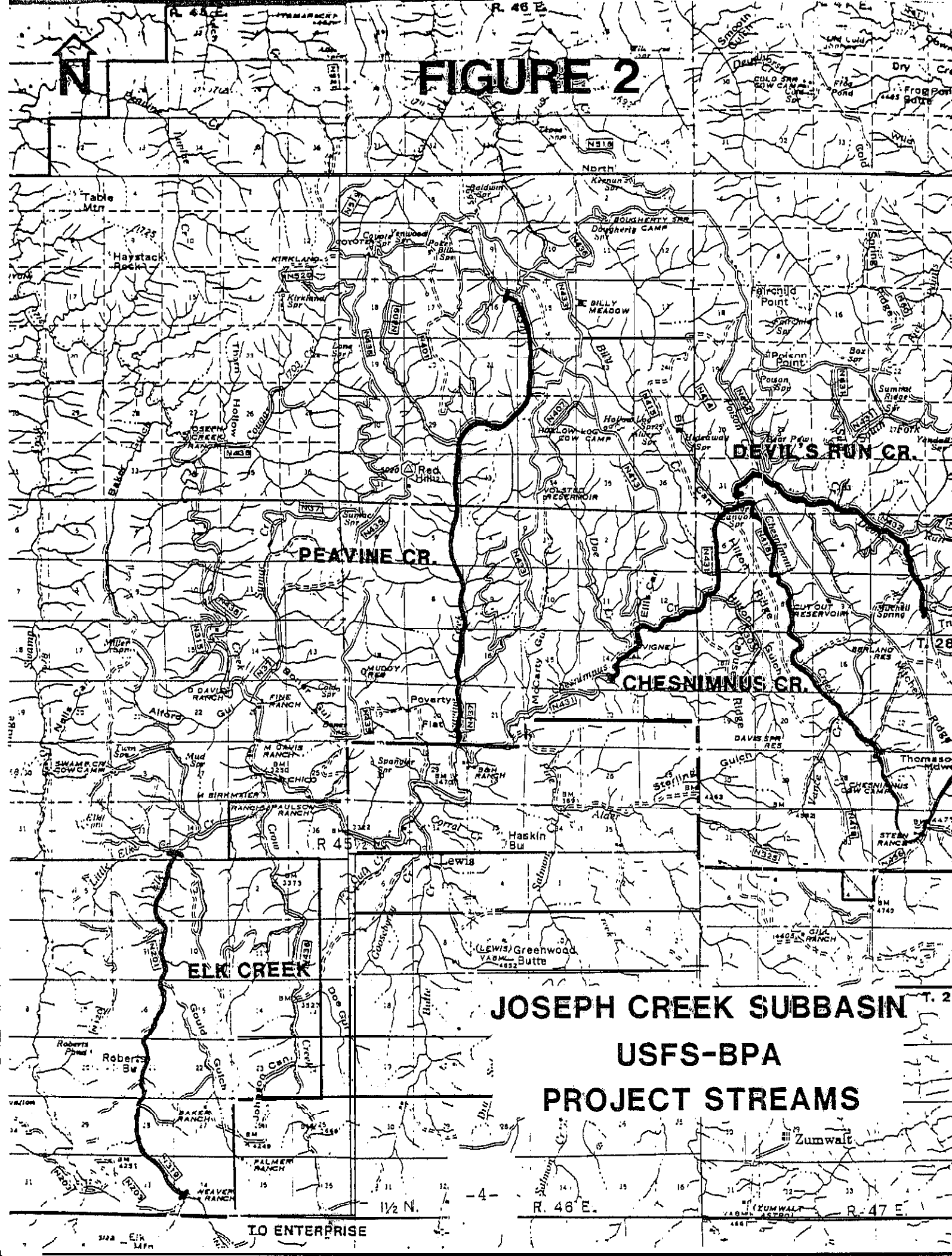


FIGURE 1

UPPER GRANDE RONDE SUBBASIN USFS-BPA PROJECT STREAMS

FIGURE 2



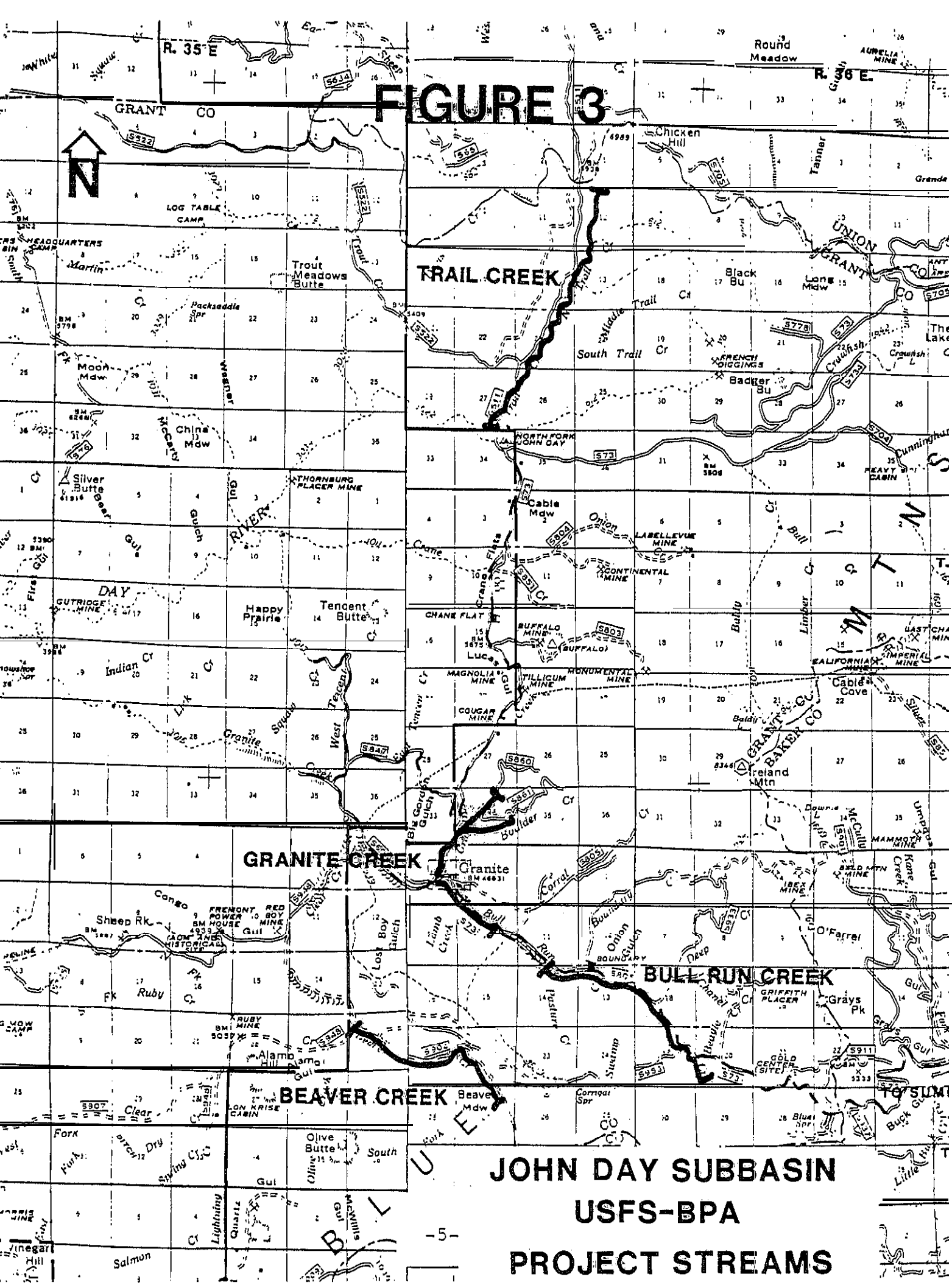


FIGURE 3

**JOHN DAY SUBBASIN
USFS-BPA
PROJECT STREAMS**

Limiting Factors

Historic patterns of land use in northeast Oregon have left most riparian areas in far less productive state than their natural potential. Placer mining in the late 1800's left many streams with little or no shade, large sediment loads, and radically disturbed channels. Inadequate control of past activities such as logging, roading, and grazing left managers with degraded habitats in most cases. Farming and irrigation of cropland in the lower portions of the basins has also significantly added to habitat loss. Symptomatic of these conditions are wide and shallow streams with low summer flows and high water temperatures, channels typically without adequate amounts of instream debris, and low in diversity.

Limiting factors associated with instream and riparian habitat degradation were identified by the Oregon Department of Fish and Wildlife, USDA-FS, and Confederated Tribes of the Umatilla Reservation. 3/ These factors are:

1. High summer water temperature - Loss of riparian vegetation and low summer flows result in water temperatures in excess of 80 degrees fahrenheit. High temperatures limit available summer smolt rearing habitat and make the cooler upstream tributaries relatively more important to salmonid production.
2. Low summer flows - Irrigation withdrawals result in extremely low flows in the Grande Ronde River. Poor watershed management practices further aggravate flow conditions, resulting in many intermittent streams which were once perennial.
3. Lack of riparian vegetation - Riparian vegetation loss, principally from ungulate overgrazing, results in many undesirable conditions. Essential fish habitat is lost along with the riparian area's ability to dampen flood peaks and increase groundwater recharge. Channels become unstable and readily erode, concentrating flows and accelerating downcutting.
4. Lack of habitat diversity - Low habitat diversity, is caused principally from the absence of large, woody debris in and along stream channels. Wood plays a critical role in maintaining stream structure and fisheries production. Past activities such as instream debris cleaning programs, have left many streams without this critical component.
5. Lack of Channel Stability - Low channel stability results from many causes: overgrazing, improper timber harvest methods, instream timber salvage, mining operations, etc. Streams, once narrow and deep, widen out and become shallower, becoming more prone to creating new channels and down cutting.

METHODS AND MATERIALS

FY 88 FS fisheries improvement implementation projects were performed by FS fish, wildlife, and range personnel using service type contracts for equipment use and project construction.

Riparian Vegetation Restoration

Fencing - Fencing to control ungulate use along riparian zones is a primary management approach used to protect and rehabilitate habitats. Two commonly used methods are riparian pasture fencing and riparian exclosure fencing. Pasture fencing usually encloses a wide section of riparian zone, allowing for future carefully controlled grazing. Riparian exclosure fencing results in permanent, narrow exclosures along riparian zones with no future grazing. Several streamside management unit fencing techniques are considered, i.e., conventional barbed-wire, smooth-wire New Zealand, and buck and pole.

Streamside Plantings - Streamside vegetation plantings were integrated with other rehabilitation measures to provide riparian shade and cover, needed to reduce water temperatures, stabilize streambanks and to supplement the release of existing natural vegetation. To ensure success and provide protection of this investment, supplemental plantings usually occurred within fenced riparian pastures or exclosures. Species most commonly planted were willow, cottonwood, alder, dogwood, and hawthorne. Plantings are made from small scions (12-16"), larger pole cuttings (3-6"), potted nursery stock from seedlings, and rooted stock from cuttings. Planting is done either by hand, auger or backhoe depending on site conditions. Planting procedures usually include scalping, excavation to the water table, mulching and fertilization.

Habitat Diversity Improvement

Adding habitat diversity to a stream channel may occur in many ways and usually results in an improvement of pool area, pool quality, spawning gravel and cover, all parameters characteristic of good habitat. The types of instream structure used include: log weirs/berms in a variety of configurations: whole tree additions with and without rootwads; rock sills/berms: rock clusters and deflectors, riprap. Both "hard" structures such as rock and log sills or weirs and "soft" structures such as whole tree additions or boulder placement were constructed. First, the sources of large woody material were identified and individual trees marked for felling. When abundant and not contributing to stream shading, trees were taken from within or near riparian zones. Soft structure additions were added at various angles, usually parallel to shore in order to maximize edge habitat. When possible, leaning trees next to the stream with attached rootwads were pushed over by the backhoe. Whole trees were cabled to their stumps or nearby debris with 3/8" galvanized cable: cabled and revetted into banks; cabled and deadmanned into banks: anchored by piling large boulders on top of the tree trunk; and left uncabled when approximately two-thirds of the tree length was above high water.

Planning, Inventorying, and Monitoring

Planning, inventory, and monitoring activities were conducted on NF lands in FY 88 in addition to habitat restoration. Each of these activities are ongoing in nature and continue to be refined.

A discussion of FY 88 accomplishments is provided in the Results section.

RESULTS

Fisheries habitat improvement accomplishments during Fiscal Year 1988 occurred in four major work activities: (1) planning, (2) habitat inventory, (3) project implementation, and (4) monitoring. Planning, inventory, and monitoring results are presented followed by habitat improvement implementation results by project.

Planning

Planning activities consisted of continued participation with subbasin technical teams in the form of draft document review for three subbasins. Additionally, a five-year (91-95) forest fisheries habitat improvement implementation plan identified KV and PM funding opportunities for inclusion in the revised Forest Plan. A critical planning need not yet addressed in sufficient detail is a joint ODFW/USDA FS/BPA identification and prioritization of improvement projects for implementation through 1995-2000. Joint implementation design review during FY 88 recommends a BPA contractual requirement for pre-project implementation peer design review beginning with Chesnimnus Creek in April 1989.

'Monitoring

Monitoring activities consisted of photopoint transects, permanent riparian vegetation transects, and structure effectiveness monitoring.

Photopoints - Photo points were re-photographed along with establishing new photopoints for instream structures along Project #2, Upper Grande Ronde River. Five before and after grazing permanent photo transects were established along Upper Fly Creek.

Riparian Vegetation - Permanent riparian vegetation transects exist on three projects, Sheep, Elk, and Chesnimnus Creeks. No permanent stations were remonitored during FY 88.

Structure Effectiveness - The effectiveness of each structure in achieving stated project goals was evaluated for three streams: Sheep, Elk, and Chesnimnus Creeks. Minor structure modifications and maintenance were performed on each of these streams, usually consisting of reinforcement of weir key ends.

Inventory

Physical and biological inventories in the Grande Ronde and John Day subbasins during FY 88 used a limiting factors analysis concept using Hankin and Reeves quantification methodology. 2/ In the Upper Grande Ronde subbasin 10.3 miles of stream along McCoy Creek were analyzed (see Appendix 5). Methods and results of the survey are available upon request.

Within major forest subbasins, streams were inventoried using COWFISH habitat model parameters to assess each streams capability to produce fish. Each survey was conducted before cattle were allowed onto the stream in the 1988 season. Smolt production and resultant returning adults

(anadromous streams) or lost wildlife/fisheries user days (resident streams) may be determined and economic value assigned once habitat capability indices have been determined.

Additional stream habitat inventory was done on several other streams in the Upper N. Fork John Day and in the Upper Grande Ronde River Subbasins. That information is summarized on Table 1.

<u>STREAM</u>	<u>HABITAT CAPABILITY INDEX ,</u>		
McCoy Creek (La Grande RD)	lower-	32%	4.8 miles
	(up to Ensign Cr.)		
	Upper-	54%	3.5 miles
Beaver Creek (Unity RD)	lower-	57%	1.7 miles
	Upper-	71%	1.4 miles
Devil's Run Creek (Wallowa Valley RD)		23%	2.1 miles
Trail Creek (Baker RD)		58%	3.0 miles

Two additional inventories were made in September 1988 after the grazing season was completed.

Camp Creek (Unity RD)	29%	3.2 miles
Bull Run Creek	59%	2.5 miles

Project Implementation

Implementation activities occurred on six active FS projects during 1988. Hard structure habitat diversity improvement activities are now complete on two of those six projects, Sheep and Elk Creeks.

The following discussion presents the current status of each active project along with FY 88 accomplishments.

Table 1. Summary of Results of FY 88 Stream Habitat Inventory

Major Drainage	Stream	#Stream	Miles of	Flow Features			Substrate					Width		Pool Characteristics		
	Name	Subsections	Streams		Run/		Boulder	Cobble	Gravel	Fine	Hard	Flood	Present	Perimeter	Surface	
		Inventoried		Pool	Glide	Riffle					Pan			Cover	Cover	
N.Fk. John Day	Onion Cr.	55	5.21	7%	33%	60%	4%	17%	58%	20%	1%	13'	5'	36%	14%	
"	"	Olive Cr.	23	2.18	14%	28%	58%	7%	32%	48%	12%	1%	22'	5'	17%	14%
"	"	N.Fk. J. Day	28	4.77	21%	28%	50%	16%	24%	37%	22%	0	53'	17'	29%	22%
"	"	Beaver Cr.	52	4.92	74%	9%	7%	1%	4%	52%	37%	4%	25'	5'	49%	42%
"	"	Bull Run	71	6.63	43%	16%	41%	11%	16%	43%	27%	2%	26'	6'	41%	26%
"	"	Middle Trail	23	3.92	37%	16%	47%	16%	23%	48%	12%	1%	27'	5'	29%	23%
"	"	South Trail	42	7.16	18%	17%	65%	16%	34%	31%	18%	1%	38'	10'	32%	21%
"	"	Trail Cr.	73	6.91	18%	17%	65%	23%	32%	41%	3%	1%	38'	12'	36%	28%
"	"	Granite Cr.	37	3.5	4%	36%	60%	11%	13%	60%	16%	0	20'	4'	23%	9%
Upper Grande																
Ronde	Dark Canyon	92	8.71	54%	20%	26%	12%	35%	41%	13%	1%	18'	7'	40%	26%	
"	"	Grande Ronde (Hilgard Sect)	21	0.5	8%	64%	18%	8%	52%	31%	8%	1%	103'	60'	21%	11%
"	"	Grande Ronde (Rifle Range to Bear Cr.)	12	0.28	11%	56%	33%	3%	74%	20%	3%	0	96'	37'	0	0
"	"	Grande Ronde (Bird Track Sec)	11	0.26	2%	79%	17%	8%	60%	29%	4%	0	79'	42'	0	0
"	"	Fly Cr.	104	2.46	20%	55%	25%	26%	44%	23%	6%	1%	43'	31'	16%	7%
"	"	Burnt Corral	50	4.73	10%	21%	49%	19%	48%	24%	8%	1%	17'	7'	39%	36%

Project I - Meadow Creek

Meadow Creek, a major subbasin of the Upper Grande Ronde River, lies within the Starkey Experimental Forest boundary. Meadow Creek and its riparian zone have a long history of impacts dating back to early logging activities. Grazing has further impacted the riparian community. Salmonid populations in Meadow Creek are composed of anadromous summer steelhead trout and resident rainbow trout. Historic Umatilla Indian tribal records document chinook salmon production in this stream. An extensive biological data base exists from aquatic research conducted since 1977.

The Meadow Creek project is a jointly funded BPA-FS improvement and evaluation project. The FS is responsible for funding all pre- and post-project improvement evaluations while BPA funds implementation activities only. The Pacific Northwest Research Station conducted both spring and fall outmigrant smolt sampling during FY 87. Their personnel also conducted an analysis of large woody debris, comparing current conditions to those of a historical U.S. Fish and Wildlife Service inventory. During FY 87, the FS also contracted with Washington State University to conduct a complete hydrological analysis of the Meadow Creek drainage, including design and location of proposal improvement structures. A preliminary research design was prepared by PNW in 1988 which identifies evaluation objectives and design for 22,400 feet of stream.

The FY 88 tasks consisted of coordinating activities associated with developing a final implementation design. The preliminary design for structure modifications was interfaced with the long term research design (Appendix 1). In total, eight out of eleven Habitat Improvement Units (HIU) will receive either full or partial treatment. A variety of integrated treatments are prescribed on four miles of stream that include one mile of game-proof fence, planting of deciduous stock, adding 1500 cu. yds. of boulders for a variety of rock structures, and constructing approximately 300 log type structures. Additional detail on specific habitat improvement measures at different locations are available upon request.

Project II - Upper Grande Ronde River

The Upper Grande Ronde River (RM 194-212) drains an area of approximately 69 square miles. A FY 85 habitat inventory of the upper reaches identified approximately three miles of poor quality salmon and steelhead spawning/rearing habitat, due primarily to past mining activities. FY 87 was the first of three years implementation work on the Upper Grande Ronde project (approximately 1 mile per year).

Specific project objectives are (1) adult holding pool construction, (2) spawning gravel retention, and (3) increase juvenile habitat diversity. Approximately one mile of additional mainstem stream was improved during FY 88 with the addition of over 175 structures, and construction of 25 large pools (Appendix 2 and 3). A hydrological engineering evaluation in June 1987 provided the preliminary design for structure placement. Work was accomplished with a personal services

contract for a Model 201-C Hydra with operator, a 580-C Case tractor and dump truck. Field work began in June and ended September 30, 1988. Additional boulders and logs were also acquired for use during FY 89.

Project III - Fly Creek

Fly Creek, a significant tributary to the Upper Grande Ronde at river mile 184, has a drainage area of 52 square miles and a stream length of about 16 miles. The stream is characterized by two general reaches. The upper 8-mile reach of stream (Fly and Little Fly) lies on private land and is a low gradient, meandering meadow-dominated reach that has been heavily impacted by livestock grazing. The lower 8-mile reach lies on NF lands and is a low-moderate gradient stream in a narrow valley bottom. Current habitat conditions on NF lands are poor. A 1985 habitat inventory identified a pool/riffle ratio of .2/.8 with low quality pools and little instream structure.

The final count of instream structures added during FY 87 and FY 88 is as follows:

Whole tree additions	206
Cable whole trees	50
Bank revetted trees	21
Dead manned whole trees	42
Boulder secured trees	35
Single log weirs	69
Boulder groupings	5
Boulder weirs	11
Side channel excavations	3

A standard single log design was used in weir construction: logs 30-35 feet in length and 18-30 inches in diameter, procured away from the stream zone, were bedded and keyed 10-15 feet into each stream bank. Twisted wire mesh (4" X 4") and geotextile cloth were used on the upstream edge. Whole tree additions were added above and below weir structures, being secured to their stumps or deadmanned into the streambank with 3/8 inch galvanized cable. All structures were placed with a personal services contract for rental of a backhoe and operator. Work began July 1 and ended August 27, 1988.

Considerable effort was also spent during FY 88 attempting to close the Fly Creek road and its five stream crossings. Physical barriers were excavated at the top of the project above the first stream crossing.

Hunters removed the first three major barriers to gain access for ATV's on two occasions. These barriers were then modified to prevent all traffic, except foot.

Habitat and Population Sampling - Fly Creek

On July 13, 1988, five photo points were established on Fly Creek (La Grande Ranger District, NE 1/4, Sec. 20, T.5 S., R. 35 E) to document future grazing affects on revegetated gravel bars by sheep. Fish densities were measured in adjacent pools to establish base line data and for

inclusion into the Fly Creek comprehensive habitat monitoring plan using limiting factor analysis procedures. Population estimates were determined using a four-pass depletion method with a backpack shocker. Areas were then measured to determine fish densities. Fish numbers, densities, and pool areas are shown in Table 2.

On July 19, 1988, 17 consecutive pools immediately upstream of the Fly Creek bridge on private land were snorkeled by an experienced diver. Age 1+ juvenile steelhead were counted and physical areas of pools were measured with a tape. Fish numbers, densities, and pool areas are shown in Table 3.

Water temperatures in Fly Creek were monitored from July 15 through August 15 using a Taylor maximum - minimum thermometer. Temperature range was from 48'~ - 80°F. The last two weeks of July found afternoon water temperatures consistently reaching 80°F daily.

Table 2. Population estimates, fish densities, and areas of five pools adjacent to photo points established on Fly Creek, July 13, 1988.

	Population Estimate		Area (m ²)	Density (#/m ²)	
	Age 0	Age 1+		Age 0	Age 1+
Pool #1	10	13	122	0.082	0.107
Pool #2	63	41	315	0.200	0.130
Pool #3	45	155 ^a	101	0.445	1.535
Pool #4	112	32	124	0.906	0.258
Pool #5	9 ^b	7 ^b	154	0.058	0.045

^a Unreliable population estimate due to non-descending removal pattern.

^b Population estimate represents only one pass due to dead battery.

Table 3. Juvenile steelhead pool densities, underwater snorkel counts, and area of pools upstream of the Fly Creek bridge, USDA FS/private lands boundary, July 19, 1988.

	Visual Count Age 1+	Area (m ²)	Density (#/m ²) Age 1+
Pool 1	19	80.7	.235
2	41	58.8	.697
3	11	144.9	.076
4	7	19.2	.365
5	7	27.9	.251
6	9	64.0	.141
7	11	64.6	.170
8	8	100.3	.079
9	4	130.0	.030
10	210	30.1	.332
11	2	23.8	.084
12	10	24.2	.413
13	6	41.6	.144
14	7	23.4	.299
15	8	35.7	.224
16	10	107.3	.093
17	10	41.8	.239
	180	1018.3	Average = .177/m ²

Project IV - Sheep Creek

Sheep Creek is tributary to the Grande Ronde River at RM 197. The drainage area comprises approximately 58 square miles. Eleven miles of stream contain spawning and rearing habitat for chinook salmon. The upper two miles of stream lie on NF land and is characterized by a moderate gradient, narrow valley floor, which is heavily timbered. The middle three miles are characterized by a low gradient, meadow/timber complex with a high degree of meander. The remaining six miles of stream are low gradient, meadow dominant, and lie on private land. Watershed uses and impacts include reading, logging, livestock grazing, and severe damage to lodgepole pine stands from insect epidemics.

Sheep Creek has received aquatic habitat improvements over a number of years. In 1980, a riparian pasture fence was constructed along one mile of stream, followed by the addition of 101 structures in 1985, creating 10,489 and 3,228 square feet of pool and cover areas, respectively.

In FY 86, riparian pasture fencing was constructed along an additional 1.6 miles of stream.

A June 1987 habitat improvement project evaluation contract with hydrologist John Osborne, Washington State University, recommended digger log modifications and additional large woody debris placements along Sheep Creek. Twenty-seven structures were modified during FY 87.

Task accomplishment for 1988 included normal fence maintenance,, photo point evaluation of structure effectiveness and planting of 3,000 3 year old Englemann spruce trees, 4,000 deciduous cuttings and 3,000 deciduous nursery stock. Deciduous stock was comprised of native alder, hawthorne, willow, red-osier dogwood and black cottonwood. First year estimates of survival appear to be 80% for the spruce and 50% for the deciduous stock.

Project V - Chesnimnus Creek

Chesnimnus Creek is tributary to Joseph Creek at the confluence with Crow Creek. The drainage area is approximately 190 square miles: about 108 square miles are on NF land. There are 12 miles of Chesnimnus Creek on NF land and about 8 miles on private land that require improvement. Chesnimnus Creek is characterized by low gradient, with short stretches of moderate gradient in the middle reaches. Narrow bluegrass meadows dominate the upper reaches, with scattered lodgepole pine overstory. The middle reaches are rocky, narrow ravines which open into broader U-shaped canyon bottoms of logged-over mixed conifer stands. The private land area is dominated by wider canyon bottoms consisting predominately of hay fields and pastures.

Watershed uses and impacts include roading, logging, livestock grazing, and farming. Numerous reaches on both NF and private ground have been channelized to accommodate road construction and hay field development.

Intensive habitat improvement work has been implemented concurrently on both private and public lands for the past several years. Program measures on NF lands to date include instream structure addition, riparian pasture fencing, and vegetation plantings.

During FY 87, the Wallowa Valley RD constructed riparian pasture fencing along 4.63 miles (243 acres) of Chesnimnus Creek. Twenty-five instream structures (weirs) were also constructed.

FY 88 accomplishments include streamside vegetation plantings in Sections A, B, and F. Plantings involved site preparation, planting, fertilizing, watering, pruning, and protection (game repellent and tree wrappings). The following presents specific planting data for each section (see Figure 4 for Chesnimnus Creek stream sections).

Section A

5/9 - 5/12

692 poles - Golden and Green Willow, Hybrid Poplar
40 hrs backhoe at 30.75/hr case 580 C
2 hrs truck at 30.25/hr

5/25 - 6/2

225 1-2' potted plants - Chokecherry, service berry
cottonwoods (Poplar Robusta)
Hand planted by FS Crew.

10/6 - 11/2

600 6' tall potted cottonwood (Poplar Robusta)	51,800
200 6' tall potted Boxelder	<u>\$ 450</u>
Planted via contract 53,920	<u>\$2,250</u>
Stock costs 52,250	

Section B

6/28 - 7/5

450 potted cottonwoods (Poplar Robusta) in 2 gal pots 1-3' tall
Planted via contract at 52/pat -5900
cost of stock 51,350

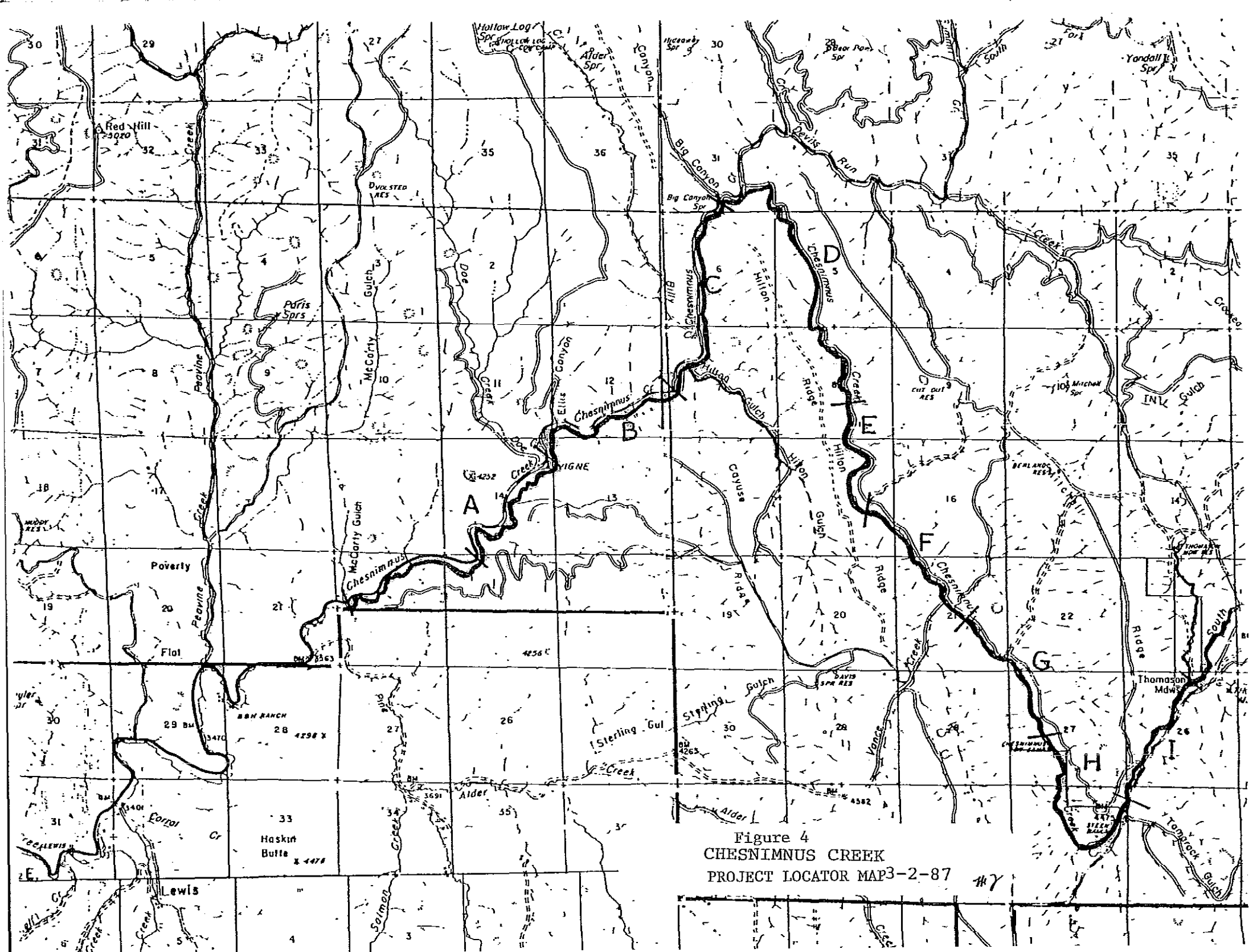
Section F

5/14 - 5/16

288 poles - Golden & Green Willow & Hybrid Poplar
14 hrs on backhoe at 30.75/hr case 580 C
2 hrs truck at 30.25/hr

5/16 - 5/24

330 potted plants 1-3' tall in 2 gal pots
110 Service berry
110 Choke cherry
110 Hybrid cottonwoods
Hand planted by FS Crew



Additional instream structure work was also accomplished as summarized below:

Instream structures

Seg A - 3 miles

Seg B - 1.5 miles
4.5 miles

37 Single log weirs
82 Boulders placed
69 Whole tree additions (cover)
33 Cabled logs laid in channel
2 Upstream "U" weirs
1 Boulder weir
4 Double wing deflectors

Equipment used:

Backhoe Cage 580 C 155.5 hrs at \$32.75/h - \$5,093
Loader Cat 931 183.5 hrs at \$32.75/hr - \$6,010
Dumphbox Trailer 43 hrs at \$35.00/hr - \$1,505

Project VI - Elk Creek

Elk Creek, a significant tributary to Joseph Creek, has a drainage of about 25 square miles, of which 16 square miles are NF lands. Approximately 12 miles of spawning and rearing stream occur within the drainage.

The stream's headwater lies within private farm, timber, and grazing lands. Sediment contributions from these uplands contribute to the current degraded condition in Elk Creek. Activities affecting water quality and streamflows include past and current logging, road construction, grazing, and farming.

Two small, riparian pasture fences were constructed along Elk Creek in 1976. By 1978 about 40 instream structures had been added. Between 1978 and 1987, the stream received about five miles of pasture fencing, another 40 instream structures, and an intensive planting of deciduous vegetation. Nine additional instream structures (log weirs) were added to Elk Creek during FY 87.

FY 88 accomplishments for Elk Creek include the following:

1) Instream structures

Seg 12 - 0.2,miles
5 log weirs

Seg 14 & 15 - 0.6 miles
11 log weirs
7 tree tops (cover)
50 boulders placed

2) Vegetation plantings

Seg 10, 11, 12, 14 & 15

Dates 5/2 - 5/7

- 1) 901 poles - Golden & Green Willow & Hybrid Poplar
- 2) 60 Hybrid Poplar rooted trees 8-12 tall
Planted with backhoe contract (Case 580 C)
54 hrs BH & 2 hrs transport at \$30.75/hr = \$1,722.00

5/20 - 5/21

- 1350 Pegs - Golden & Green Willow & Hybrid Poplar
1-2' in length
Hand planted with FS Crew

6/28 - 7/5

- 450 Potted Cottonwood (Poplar Robusta) trees
3-6' tall in 2 gal pots
Hand planted by contact - \$900
Stock cost - \$1,350

Total Treated - 1.4 miles

Equipment used - Backhoe - Case 580C
Loader - Cat 931
Dumpbox trailer
Truck trailer - Ford HD400

Project VII - Devil's Run Creek

Devil's Run Creek is a small tributary to Chesnimnus Creek. This stream, inventoried in September 1986, has been heavily impacted by timber blowdown, logging, fire, and grazing. The lower three miles of stream exhibit little instream cover and low structural diversity. Juvenile young-of-the-year salmonids are abundant, but overwintering habitat is poor. FY 87 activities were limited to the tentative location of riparian pasture fencing along two miles of stream and preparation of a detailed budget for FY 88 design activities.

Project VIII - Peavine Creek

Peavine Creek, a tributary to Chesnimnus Creek, has a drainage area of approximately 26 square miles. Peavine Creek's stream channel has received extensive alteration, primarily from road building and logging. Three small riparian exclosures were constructed near the mouth of Peavine Creek, in 1970. These exclosures dramatically show the effectiveness of riparian exclosure fencing and received plantings of cuttings and rooted, deciduous stock in 1975. In 1984, using BPA funding, the stream received 51 instream structures and 3.25 miles of riparian pasture fencing.

FY 87 activities along Peavine Creek consisted of repowering the solar-electric fence to prevent ungulate grazing within the riparian zone.

FY 88 improvements along Peavine Creek were the following vegetation plantings within exclosures #4 and #5:

Dates 11/4 - 11/16

	Planted - Rooted stock
95	Russian Olive 9-12' tall
95	Golden Willow 12' tall
95	Aspen 8-10' tall
50	Mt. Ash 8-12' tall
30	May Day (Prunus Padus) 8-12' tall
<u>15</u>	Green Ash 8-12' tall

390 at a cost of \$4,539.00

27 hrs backhoe time at 32.75/hr	Case 580c	= 884.25
8 truck time at 32.75/hr	Ford HD400	<u>226.00</u>
		\$1,146.25

Project IX - Riparian Vegetation Plantings

Vegetation plantings in riparian areas, used in conjunction with other rehabilitation measures, prove effective in providing riparian shade and cover, two essential components of good fish habitat. Extensive plantings have occurred in the Lower Grande Ronde subbasin, beginning in 1975 with Peavine Creek. More planting occurred in 1983 and 1984 on Peavine and Elk Creeks, and during FY 87 these two streams and Chesnimnus Creek received intensive spot plantings. Chesnimnus Creek received 6,685 plantings, Elk Creek 1,920, and Peavine Creek 600. No plantings occurred in the Upper Grande Ronde subbasin in FY 87, although a procurement contract for the FY 88 delivery of 4,000 rooted stock of mixed species was awarded to the Tree of Life Nursery. These rooted stock were planted by contract along with approximately 2,000 willow poles in early FY 88.

The success rate of streamside plantings has been highly variable. Elk and Peavine Creek planting survival is estimated at 80 percent while Sheep and Chesnimnus Creeks are lower, from 20-50 percent. A non-BPA project, Swamp Creek, has a near 100 percent survival of plantings. The success of streamside plantings is highly correlated several factors, i.e., site selection, handling care, planting method, and species. Both spring and fall plantings are successful, if proper care is taken. To ensure this, future plantings occur by contract through established nurseries.

Appendix 4 shows some before and after photos of the results of riparian planting.

SUMMARY AND CONCLUSIONS

Significant progress has occurred toward improving fisheries resources in the two project subbasins. Recognition of the need to treat habitat units with a combination of treatments is now widespread. Habitat diversity improvements have evolved from single, "hard" engineered structures to diverse, "soft" engineered combination of treatments more representative of natural systems. Also recognized is the need to protect instream improvement investments with strict and judicious management and administration of riparian zones. Research and management applications continue to evolve, along with the understanding that there is no "quick fix." Significant effort is and continues to be focused on clearly measuring and defining riparian management objectives.

System and subbasin planning efforts are proving instrumental in reaching short term improvement goals and providing long-term direction. The Wallowa-Whitman recognizes the abundant opportunities for habitat improvement and is striving to provide additional fisheries expertise at the district level for all forest subbasins.

LITERATURE CITED

1. Oregon Department of Fish and Wildlife. 1986. U.S. v. Oregon, Grande Ronde River spring chinook production report. Portland, Oregon. 36pp.
2. Same as above
3. James, Garry. 1984. "Recommended Salmon and Steelhead Improvement Measures." Confederated Tribes of the Umatilla Indian Reservation. 59pp.
4. Uberuaga, Richard. 1988. Wallowa-Whitman NF Fish Habitat Improvement Implementation Plan. USDA Forest Service, Baker, Oregon.

APPENDICES

Appendix 1

TECHNIQUES TO ACCELERATE RECOVERY OF STEELHEAD TROUT HABITAT FOLLOWING GRAZING AND LOGGING IN MEADOW CREEK, OREGON

OBJECTIVE:

- 1) Document changes in woody riparian vegetation and stream channel dynamics resulting from several treatment regimens in middle Meadow Creek basin.
- 2) Document changes in fish habitat (riffles, pools, glides, substrate, cover) and fish community structure (salmonids and non-salmonids) resulting from several treatment regimes in middle Meadow Creek basin.
- 3) Document changes in summer and winter water temperatures resulting from several treatment regimes in middle Meadow Creek basin.

DESIGN:

The middle reach of Meadow Creek on Starkey Experimental Forest will be divided into 4 approximately one mile segments, starting at the downstream boundary of Starkey Experimental Forest and progressing upstream. Divisions will coincide with previous study sections defined as Phase I, II, III, and IV.

Phase I is a one mile reach with a primarily timbered narrow floodplain. Riparian vegetation consists of true fir, yellow pine, larch, some scattered spruce at the upstream end, and willow and alder. The area was subjected to streamside timber harvest in the 1950's and earlier, and has been variably subjected to season-long livestock grazing for the past 6 to 10 years.

Treatment: The riparian area currently is fenced to control movements of livestock, but not movements of big game. Treatment in this area will exclude livestock use in the riparian zone beginning in 1990, but allow free access of deer and elk. Habitat treatment in the upper half of the reach will consist of protection of riparian vegetation from livestock use only. Riparian vegetation will also be protected from livestock use in the lower half of the reach, and pool habitat will be increased to 20 high quality pools (>3 feet deep with wood and boulder cover) per mile.

Phase II is a 1.25 mile reach with a wide floodplain dominated by dry meadows. Riparian vegetation consists of grasses and forbs with scattered alder, willow, and conifers. The area has received a variety of grazing treatments in the last 10 years, including a non-grazed control, two rest rotation pastures, a deferred rotation pasture, and a season long pasture.

Treatment: Sections 2, 3, and 4 of this reach will be fenced with a game and livestock-proof fence. High quality pools at the rate of 20 per mile will be added to the upper half of the fenced section. The lower half will receive no pool development. Riparian vegetation in the entire fenced area will be allowed to grow naturally without the influence of grazing animals. Section 5 of Phase II (ungrazed since 1975) will also receive a treatment of pool

development. Section 1 of Phase II will receive season-long livestock grazing and no pool development.

Phase III is a one mile reach beginning at the concrete bridge over Meadow Creek on the Starkey Experimental Forest and extending upstream. The riparian area is enclosed by a game-proof fence. The enclosure is divided into 5 sections, each about 0.2 miles in length. The downstream section has been ungrazed since 1975, and the upper 4 sections have each been subjected to various livestock grazing treatments. Riparian vegetation consists of grasses, forbs, alder, willow, and conifers.

Treatment: Section 5, the ungrazed control, will remain in ungrazed status and will receive no pool development work in the channel. Sections 3 and 4 will continue to receive livestock use (rest rotation in 4 and deferred rotation in 3) with no pool development work in the channel. Sections 1 and 2 will continue to receive livestock use (season-long in 2, and rest rotation in 1) and both will be subjected to pool development at a rate of 20 high quality pools per mile.

Phase IV is a one mile reach beginning at the downstream Starkey Experimental Forest boundary and extending upstream to the first concrete road bridge over Meadow Creek. The area has been exposed to both game use and short duration high intensity livestock use for the last decade, and timber in the riparian zone was intensively harvested historically. The riparian community consists of conifers, willow, alder, and forage plants. The flood plain is narrow through most of the reach.

Treatment: The downstream half of the reach will continue to be grazed by game and livestock and will undergo pool development at a rate of about 20 pools per mile. The upstream half of the section will continue to be grazed, but no pool development is planned for the area.

Summary of Treatments:

- 1) No livestock, no game, no pool development (Phase II, 0.4 mi.)(new enclosure).
- 2) No livestock, no game, pool development (Phase II, 0.4 mi.)(new enclosure).
- 3) Livestock, no game, no pool development (Phase III, 0.4 mi.)(existing game fence).
- 4) Livestock, no game, pool development (Phase III, 0.4 mi.)(existing game fence).
- 5) No livestock, game, no pool development (Phase I, 0.5 mi.)(existing stock fence).
- 6) No livestock, game, pool development (Phase I, 0.5 mi.)(existing stock fence).
- 7) Livestock, game, no pool development (Phase IV, 0.5 mi.)
- 8) Livestock, game, pool development (Phase IV, 0.5 mi.)

- 9) Livestock, game, no pool development (Phase II, 0.25 mi.)(section to allow upland cows access to water).
- 10) No livestock, no game, no pool development, with 14 years protection of riparian vegetation (Phase III, 5, 0.25 mi.)

Appendix 2

AERIAL PHOTO OVERLAYS OF LOCATION AND TYPES OF IMPROVEMENT STRUCTURE

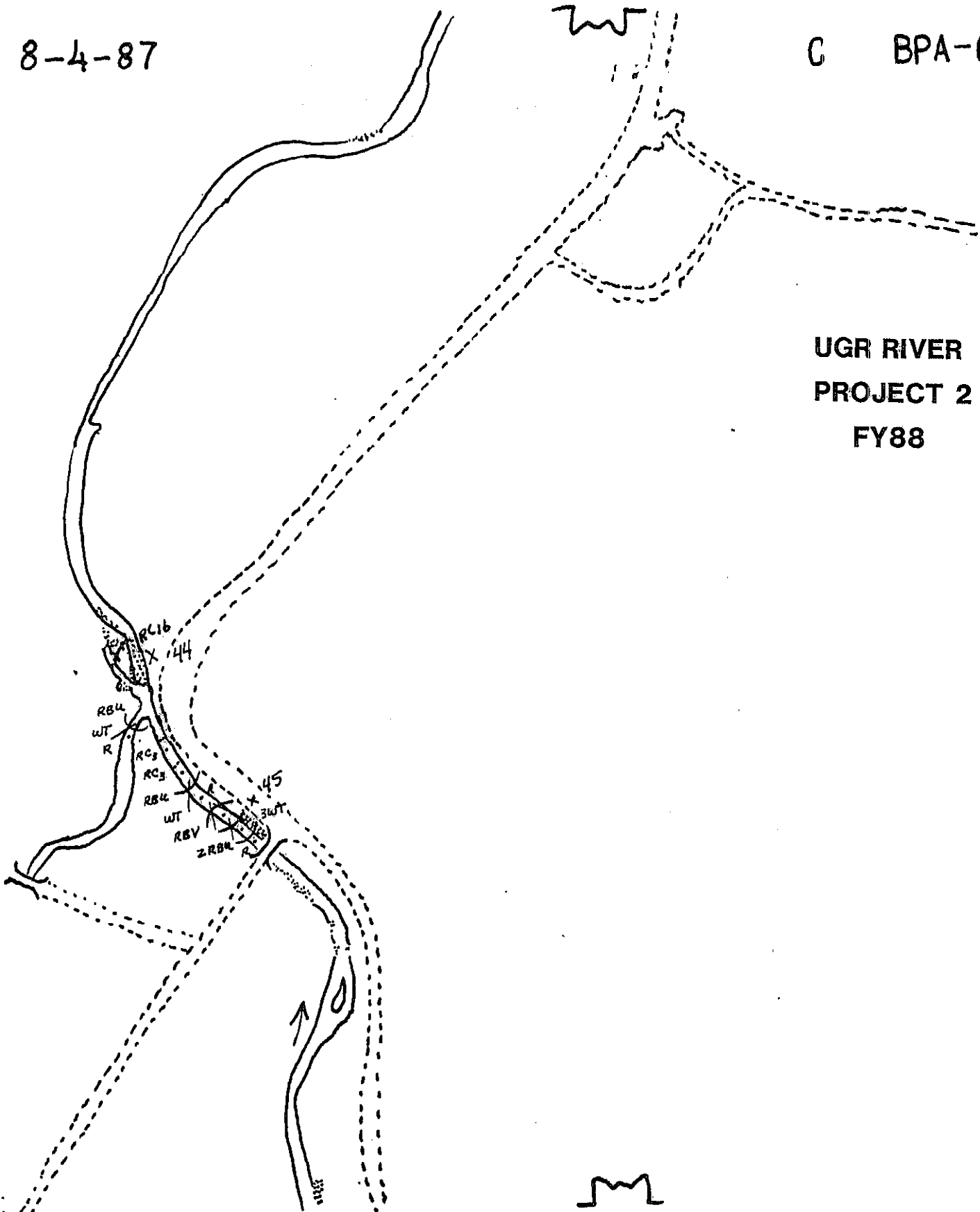
UGRR Structure Legend FY 88

RBV	Rock Berm Upstream
RBV	Rock Berm Downstream
R	Single Boulder
RCle.3	Rock Cluster
RR	Rip-Rap
RT	Turning Rock
LS	Log Sill
LB	Log Berm
LSV	Log Sill Downstream "Vee"
LJ	Log Jam
BPT	Bank Protection Trees
WT	Whole Trees

8-4-87

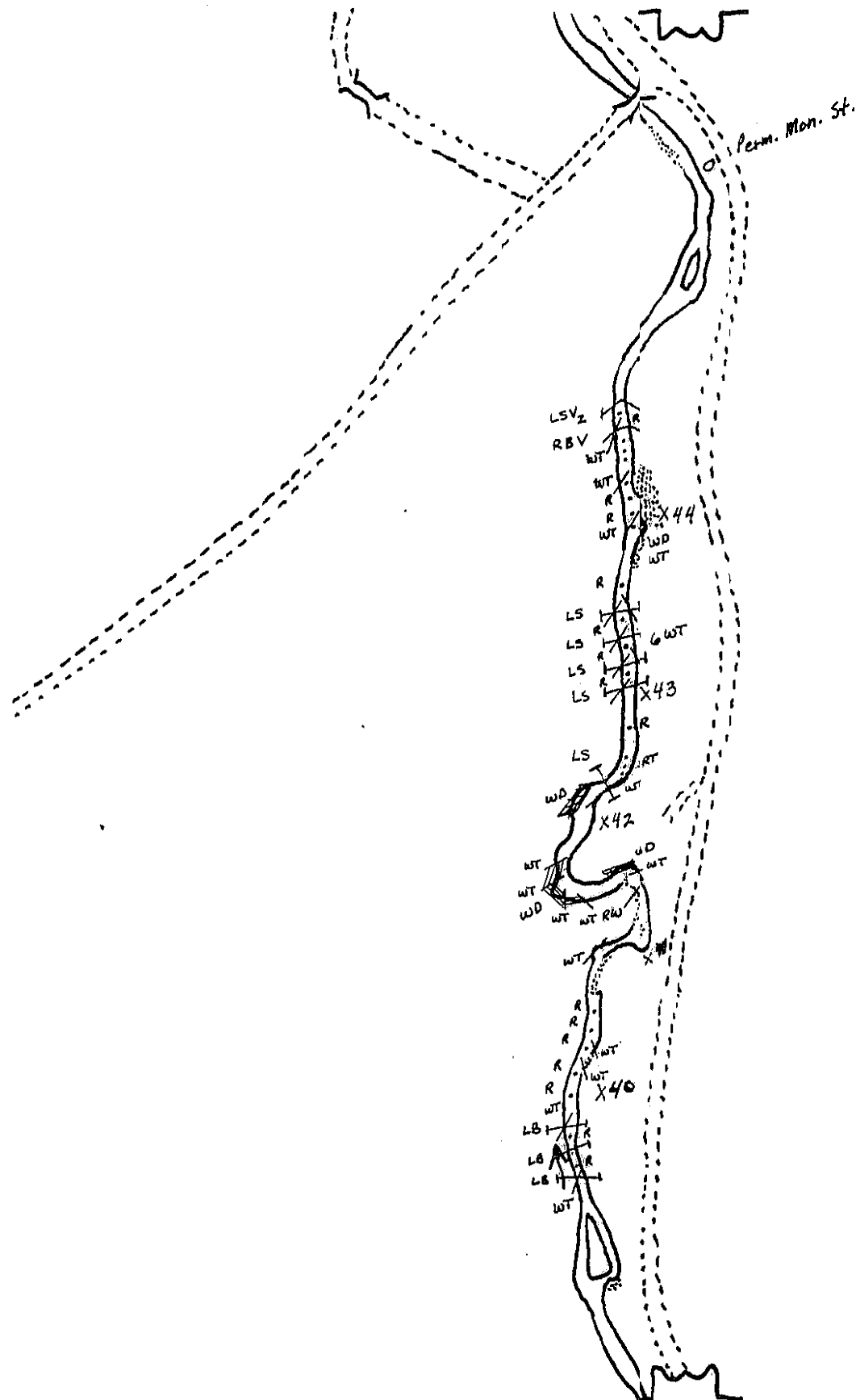
C BPA-GRGRR

UGR RIVER
PROJECT 2
FY88



C BPA-GRGRR 1-

**UGR RIVER
PROJECT 2
FY88**



C BPA-GRGRR 1-

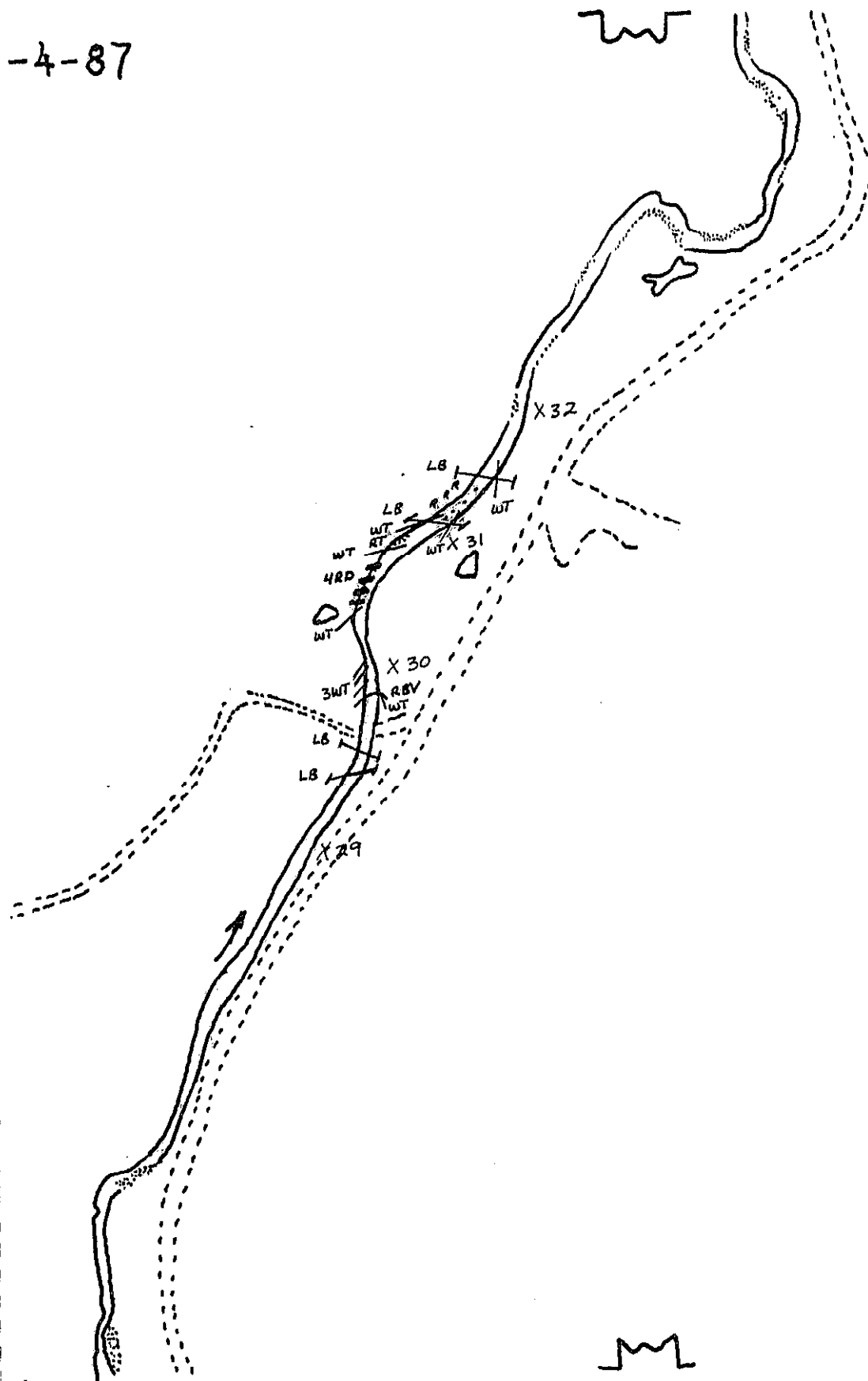
C BPA-GRGRR

UGR RIVER
PROJECT 2
FY88

-4-87

C WA-GR6 RR 1-8

UGR RIVER
PROJECT 2
FY88



Appendix 3

UPPER GRANDE RONDE RIVER STRUCTURE TALLY FY 88

Subsection	Structure Type	Complex	Pieces
44-45	4RBU; RBV; 5WT; 5R; 2RC3; RR	17	21
43-44	4LS; LSV2; RBV; 9WT; 12R; WD	28	28
42-43	LS; 2WT; 3RT; R; RR	6	8
41-42	8WT; 3WD; RW	12	12
40-41	4WT; 4R	8	8
39-40	3LB; 2WT; 3R; RR	9	9
38-39	3LB; LS; RBV; 8WT; 3R; RC3; LJ; RR	18	20
37-38	4RBU; 8R; 3WT	15	15
36-37	2LB; LS; 3RBV; 4WT; RC4; RR	13	16
35-36	LS; 4BPT; 4RT; RR	7	10
34-35	4RD	4	4
33-34	3LB; 2WT; 2R; BPT; RR	7	7
32-33	4WT; 5RT; RC3	10	12
31-32	2LB; 3R; 3WT; RR	9	9
30-31	4RD; RT; 2WT	3	7
29-30	2LB; RBV; 4WT; RR	7	7
		175	193

Appendix 4

BEFORE AND AFTER RIPARIAN PLANTING PHOTOS

Appendix 5

U. S. Forest Service Physical and Biological Fisheries Inventory McCoy Creek - La Grande Ranger District

BACKGROUND

McCoy Creek, a Class I stream, lies within the Grande Ronde Basin. McCoy Creek contains an anadromous run of summer steelhead and a limited resident population of brook trout and rainbow trout. Suckers and sculpins are also common throughout the lower reaches of the stream.

Limiting Factors Analysis, an instream habitat survey, was conducted from June 8 through July 12, 1988 on about 9.2 mainstem miles and 1.1 miles of tributaries of McCoy Creek beginning at the Forest Service boundary (NW 1/4, Sec. 12, T. 3 S., R. 34 E.) and continuing upstream until the stream became dry (SE 1/4, Sec. 11, T. 3 S., R. 33 1/2 E.) to identify factors limiting to salmonid production. The COWFISH model was also applied to 40 100 foot stream sections at 1,000 foot intervals to assess existing fish production, fish loss, and economic loss.

Steelhead production in McCoy Creek has been limited in the past by low flows, water temperatures approaching upper lethal limits (77°F), and lack of adequate spawning gravel. In this survey, we estimated fish abundance and total habitat area of pools and riffles.

METHODS

Limiting Factors Analysis

The scope of this survey was to determine the quantity and quality of habitat in McCoy Creek. Therefore, we classified habitat unit types into pools and riffles. One individual made a visual estimate of habitat unit's length, width, and depth; then two people accurately measured the area of that habitat unit in systematic samples of one out of five pools and one out of ten riffles for the entire length of the stream. Dominant substrate, lineal length of undercut bank, number of pieces of wood, and area of spawning gravel were also estimated at each habitat unit. Estimates of total habitat areas, associated variance, and 95% confidence intervals were determined for the entire length of the stream.

Habitat units that were to be sampled for fish numbers were flagged. One out of ten riffles and one out of five pools were sampled for fish numbers. Habitat units were sampled about three weeks later by proceeding upstream and making a one-pass estimate with a backpack shocker. Rainbow/steelhead trout and brook trout were measured to the nearest mm and enumerated; other species were identified and counted. Length-frequency distribution was used to determine age class of rainbow/steelhead trout.

A four-pass depletion - removal method was used to estimate fish numbers in one out of five habitat units. Calibration ratios were determined for each habitat type to adjust for numbers of fish not captured on the first pass.

Cowfish

The COWFISH model considers six variables in determining a stream's capability to support trout. These variables are: % undercut bank, % vegetative overhang, % streambank alteration, stream embededness, stream width, and stream depth. Each of these variables was estimated for every 100 feet section. Each variable is converted to a parameter suitability index (PSI), which were averaged to determine percent of habitat optimum for fish. The model then determined existing fish production, fish loss, recreation loss, and economic loss based on percent of habitat optimum, stream gradient, soil type, and Wildlife and Fish User Days (WFUDS).

RESULTS

Limiting Factors Analysis

Calibration ratios between visual estimates of habitat unit areas and accurately measured areas was 1.1183 for pools and 1.2039 for riffles. Estimated total area of pool habitat for the 9.2 mile reach was 11,388 m² and riffle habitat was 58,827 m² (Table 1). Average area of riffles was about five times that of pools and both habitat units decreased in average size closer to the headwater (Table 2).

Estimated total abundance of rainbow/steelhead trout in pools and riffles within the 9.2 mile reach was 1515 and 1713, respectively (Table 3). Mean estimated densities of fish per habitat area were five times greater in pools than riffles, while mean number of fish per habitat unit were similar between both habitat types (Table 4).

Large gravel was the dominant substrate in both pools(37.1%) and riffles (52.2%) (Table 5). However, very little gravel was suitable for spawning because of embededness. The area of spawning gravel in pools was 100 m. and in riffles was 284 m². Wood was frequent throughout the stream especially in the upper reaches. The most predominant type of wood in both pools and riffles was that wood that was longer then the bankful width (Table 6.).

The stream width/depth ratio was 32 which is poor. Low ratios mean the stream is vulnerable to flood damage and winter icing is more prominent, thereby reducing overwinter rearing habitat. Stream temperature in the lower reaches were around 70°F in the late afternoon. Temperatures in the upper headwaters were significantly cooler at 54°F. Temperature data for McCoy Creek can be obtained by contacting Oregon Department Fish and Wildlife, La Grande District.

The physical habitat inventory was performed on tributaries of McCoy Creek. The inventory ceased when the tributary became dry or gradient exceeded 5%. The biological survey was not performed because the tributaries were dry three weeks later. The estimated total area of pool habitat and riffle habitat in the tributaries was 573 m² and 2,468 m², respectively (Table 7).

Cowfish

McCoy Creek was divided into lower and upper reaches for COWFISH analysis based on apparent differences in stream and riparian conditions. The lower reach, McCoy Creek below the Ensign Creek confluence downstream to the Forest boundary, was in poor condition, as evidenced by being 32% of habitat optimum. The upper reach, above the Ensign Creek confluence, was in fair condition at 54% of habitat optimum. Results for lower McCoy Creek and upper McCoy Creek are shown in Table 8.

DISCUSSION

This stream survey revealed that inadequate pool to riffle ratio, inadequate depth to width ratio, late season low flow, increased water temperature, and lack of quality spawning gravel limit production of fish numbers. Furthermore, lack of streamside vegetation increases water temperature and algal growth. Extensive grazing has caused bank instability and subsequent sedimentation.

Enhancement projects should be implemented to create more desirable fish densities. Densities upwards of 0.3 fish per square foot could be achieved with proper fish habitat management. Spawning gravel could be increased by manipulating the stream bed or by placing quality gravel onto the existing stream bed. Trash catchers would be installed to catch gravel and prohibit it from being washed downstream. Pools could be increased by the creation of log weirs, rock weirs, and by deepening the existing channel. Planting willow and cottonwood cuttings along the stream edge will help stabilize the bank and in the long term provide shade, decrease water temperatures, and narrow the stream channel. A healthy riparian zone could be obtained by creating riparian pasture or exclosure fencing. Fencing will keep cattle away from the stream, thereby decreasing nutrient runoff from defecation and will ultimately decrease algae growth and allow stream banks to stabilize and revegetate.

The Oregon Department of Fish and Wildlife is currently installing log weirs and fencing 8 miles of McCoy Creek on private land downstream from the forest boundary. It is important to take a total watershed approach in enhancing McCoy Creek and work in conjunction with ODFW. The benefits from ODFW's work will only be minimal if measures are not taken to enhance the upper reaches and headwaters of McCoy Creek. The degradation of the upper watershed has a cumulative effect on the downstream reaches and therefore current grazing practices must be altered in conjunction with stream rehabilitation.

Table 1. Total number of units (N), number of units accurately measured (n), calibration ratios of accurately measured areas to visually estimated areas (R), estimated total areas of all units (Y_R), estimated variances for estimated total areas ($V(Y_R)$), and 95% confidence intervals for estimated total areas (95% C.I.) for pools and riffles in mainstem McCoy Creek during June and July 1988. Areas are in meters squared.

HABITAT TYPE	N	n	R	Y_R	$V(Y_R)$	95% C.I.
	555					
Pools	581	111	1.1183	11,388	31,459	\pm 355
Riffles		58	1.2039	58,827	804,952	\pm 1,794

Table 2. Total area of all habitat units (Tx), total number of habitat units (N), and average areas (X) of pools and riffles in mainstem McCoy Creek during June and July 1988. Areas are in meters squared.

HABITAT TYPE	N	TX	X
Pools	555	10,183	18.3,
Riffles	581	51,179	88.1

Table 3. Estimated abundances (Y) of rainbow/steelhead trout, total number of habitat units (N), total number of habitat units sampled (n), and estimated variances of abundance estimates ($V(Y)$) in pools and riffles in mainstem McCoy Creek during June and July 1988.

HABITAT TYPE	N	n	Y	$V(Y)$
	555			
Pools	581	111	1,515	32,488
Riffles		58	1,713	141,234

Table 4. Mean numbers per habitat unit (Y) and mean densities per unit of habitat area (Y/X in fish/ m^2) for rainbow/steelhead trout in pools and riffles in mainstem McCoy Creek during June and July 1988.

HABITAT TYPE	Y	Y/X
Pools	2.7	.148
Riffles	2.9	.033

Table 5. Percent composition of substrate in pools and riffles in mainstem McCoy Creek during June and July 1988.

SUBSTRATE	POOLS	RIFFLES
Organic Debris	1.2	
Clay	0.4	
Silt	25.8	10.0
Sand	0.9	0.2
Small Gravel	25.9	22.9
Coarse Gravel	38.1	52.2
Boulder	0.2	14.8

Table 6. Number of pieces of persistent wood in pools and riffles in mainstem McCoy Creek during June and July 1988.

CATEGORY OF WOOD	POOLS	RIFFLES
Longer than bankful width	790	1,079
> 30 ft.	281	465
10-30 ft.	94	175
6-10 ft.	351	447

Table 7. Total number of units (N), number of units accurately measured (n), calibration ratios of accurately measured areas to visually estimated areas (CR), estimated total areas of all units (YR), estimated variances for estimated total areas (V(YR)), and 95% confidence intervals for estimated total areas (95% C-1.) for pools and riffles in 1.1 miles of tributaries to McCoy Creek during June and July 1988. Areas are in meters squared.

HABITAT	TYPE	N	n	R	YR	V(YR)	95% C.I.
		85					
Pools		86	16	1.087	573	277	\pm 33
Riffles			7	1.044	2,468	38,477	\pm 392

Table 8. Results of the COWFISH model on lower and upper reaches of McCoy Creek, June and July 1988.

	<u>LOWER</u>	UPPER
Stream length sampled,	4.8 miles	3.5 miles
Streambank undercut		
%	1.5	6.6
PSI Value	0.0	0.10

Vegetative cover overhang		
%	29.2	43.6
PSI Value	0.45	0.65
Streambank soil alteration		
%	37.9	21.4
PSI Value	0.65	0.86
Stream embeddedness		
%	39.3	23.3
PSI Value	0.40	0.75
Stream width/depth ratio		
Actual	37.5	24.3
PSI Value	0.10	0.34
Average PSI	0.32	0.54
Percent of Habitat Optimum	32.0	54.0
Optimum Stream Width	7.5	4.5
Stream Gradient	2%	3%
Granitic Soils	NO	NO
Optimum Fish Production		
per 1000 feet	48	32
per length sampled	1,214	598
Existing Fish Production		
per 1000 feet	15	17
per length sampled	380	318
Fish Loss		
per 1000 feet per year	33	15
per length sampled per year	834	280
Recreation Loss		
WFUD per 1000 feet per year	5.5	2.5
WFUD per length sampled/year	139.2	46.8
Economic Loss		
per 1000 feet per year	\$351	\$160
per length sampled per year	\$8,888	\$2,986
Longer than bankful width	12	6
730 ft.	45	31
10-30 ft.	60	45
6-10 ft.	8	5
Pool/Riffle Ratio - 1:3		